Physics 11 Laboratory: Springs and Elastic Potential Energy **Name:__________________**

Objectives:

Materials: **Diagram:**

Retort stand
Hook clamp
Weight hanger
Set of masses
Coil spring
Metre stick

Procedure:

1. Attach the clamp to the retort stand.

2. Hang the spring by one end from the stand clamp over the edge of a desk.

3. Measure the height of the spring above the floor. Record this value in the first row of the spring apparatus data table. This value will be your equilibrium value, h_o, at which you will assign the value of zero to the extension of the spring, x. This should be the only non-zero value in the first row of the data table below.

4. To create an applied force, attach a mass hanger to the end of the spring (50 g) plus another 50 g mass. Wait for the spring to come to rest and measure the height of the spring above the floor. Record this value in the data table.

5. Continue adding more masses until you have done seven readings in addition to the equilibrium reading. Make sure that you do not overextend the spring.

6. Complete the second column in the table by calculating the value of the applied force (weight of the mass), and the forth column by calculating the extension of the spring for each mass relative to the equilibrium position ($x = h_o - h$).

Data:

1. Compile your spring apparatus data into the table below:

Mass m (kg)	Applied Force, F (N)	Height of spring above floor, h (m)	Extension of spring, x (m) $x = h_o - h$	Elastic Potential Energy of Spring, E_e (Joules)
0.000				
0.100				
0.200				
0.300				
0.400				
0.500				
0.600				
0.700				

2. a) Draw a graph of the applied force versus the extension of the spring.
   Note: Normally you would put the independent variable (in the case, the applied force) on the x-axis and the dependent variable (in this case, the extension of the spring) on the y-axis. However, the mathematics involved in determining the relationships between these variables will be simplified by plotting the applied force on the y-axis and the extension of the spring on the x-axis.

   b) Draw a line of best fit through the data points.

   c) Describe the line and determine the equation of the line. The slope of the line is equivalent to the spring constant of your spring. What is your spring constant?

3. Using your calculated spring constant, calculate the elastic potential energy of your spring which each mass, and fill in the last column of the spring apparatus table.

4. Using your graph, estimate the extension distance of the spring when the following forces are applied to it:

Force Applied (Newtons)	**Extension of spring, x (meters)**
2	
4.5	
6	
8	

5. a) Calculate the area under the line of your graph from the ***last data point.***

   b) Compare the area you calculated to the elastic potential energy of your last data point in the spring apparatus table by calculating the % deviation (p. 939). What do you notice?

Analyze and Conclude:

1. State the relationship between the applied force and the extension of the spring.

2. How can the energy of a spring be determined?

3. Did the elastic potential energy stored in the spring decrease or increase as more weight was added to the weight hanger?

4. Why would it be important to be able to describe the behavior of a spring and its extension distance under certain forces? What are some real-life applications of Hooke's Law?

References: